



Flood Risk Assessment and Surface Water Drainage Strategy

Wymondley Battery Energy Storage System

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Acronyms and Abbreviations

AEP	Annual Exceedance Probability
BESS	Battery Energy Storage System
bgl	Below ground level
BGS	British Geological Survey
EA	Environment Agency
FRA	Flood Risk Assessment
GPR	Ground-Penetrating Radar
m aOD	Metres above Ordnance Datum
NGR	National Grid Reference
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
SuDS	Sustainable Drainage Systems
SWDS	Surface Water Drainage Strategy



1.0 Introduction

1.1 Context

SLR Consulting Limited has been appointed by Pivoted Power (part of EDF Energy Renewables Ltd) (EDF-R) to prepare a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) for a proposed Battery Energy Storage System (BESS) on land off Stevenage Road, Ashbrook, Little Wymondley, Hertfordshire, SG4 7JL ("the site").

This report has been completed in accordance with guidance presented within the National Planning Policy Framework¹ (NPPF) and its associated Planning Practice Guidance² (PPG), taking due account of current best practice documents relating to the assessment of flood risk published by the British Standards Institution BS8533³.

1.2 Site Location

The BESS site is located to the northwest of Stevenage centred around National Grid Reference (NGR) TL(52) 21578 26739. At present, the site comprises of agricultural land. The red line boundary includes a grid connection route from the main development area extending west towards the existing National Grid substation. The village of Little Wymondley is present approximately 500m to the north of the site. The proposed development masterplan is contained as Appendix A.

A site location is provided overleaf as Figure 1-1.

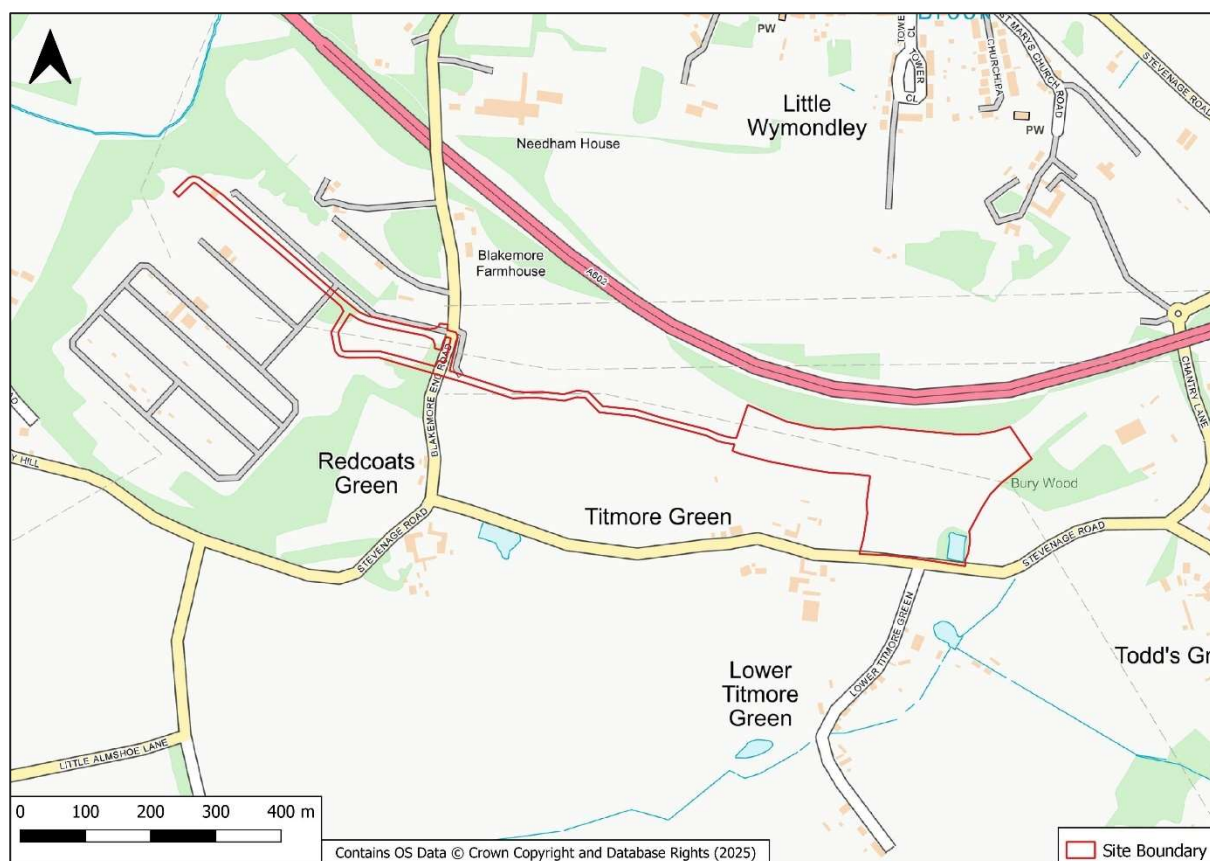
1 Revised National Planning Policy Framework: Communities and Local Government (updated December 2024)

2 Planning Practice Guidance: Communities and Local Government (August 2022)

3 BS8533:2017, Assessing and managing flood risk in development: Code of Practice (December 2017)



Figure 1-1: Site Location Plan



1.3 Administrative Context

The site falls under the planning jurisdiction of North Hertfordshire District Council who are responsible for the determination of this application. Hertfordshire County Council are the Lead Local Flood Authority (LLFA) for the area, responsible for dealing with localised flood risk and drainage issues.



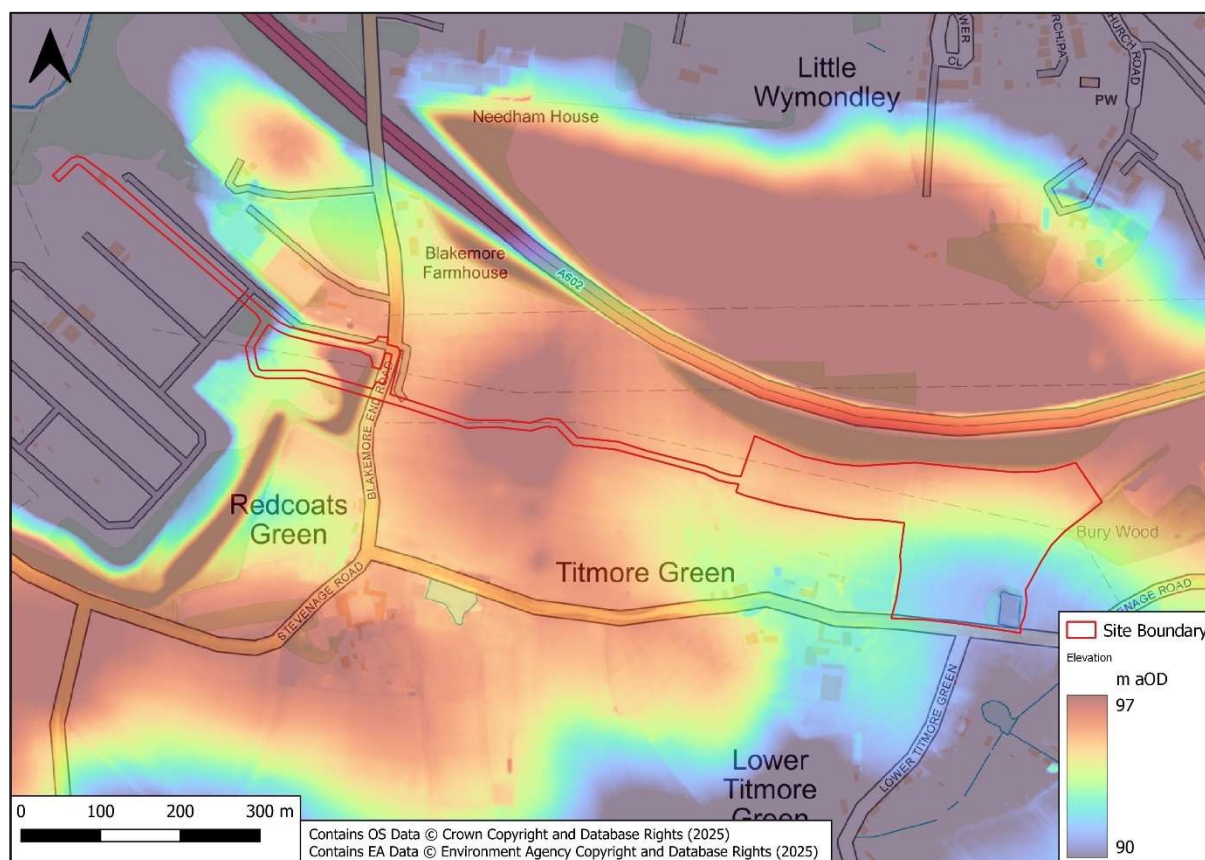
2.0 Baseline Site Appraisal

2.1 Topography

The Environment Agency (EA) has collected and compiled a Light Detection and Ranging (LiDAR) database for the UK⁴. LiDAR is an airborne mapping technique to measure distance between the land surface and the aircraft and thereby can get an accurate reading of the terrain. The LiDAR for the site can be seen in Figure 2-1.

The data presented is a Digital Terrain Model (DTM). This is a bare earth model and therefore excludes features such as built development and vegetation.

Figure 2-1: Local Topography



Ground levels at the site slope south towards the tributary of the Ash Brook ranging from 96.3m above Ordnance Datum (aOD) in the northwest of the site compound area to 90.4m aOD along the southern site boundary. A raised embankment is located to the north of the site to around 99.0m aOD along the A602. The A602 is sited beneath the embankment to around 95.6m aOD.

Ground levels along the cable route pass through an area of raised topography (97.8m aOD) before entering the National Grid Substation and falling west towards the Ash Brook to approximately 82.6m aOD.

4 Environment Agency, LiDAR database, <http://environment.data.gov.uk>



2.2 Local Hydrology

The Ash Brook, at its closest point, is c.1.2km west of the BESS area and flows in a largely westerly direction Little Wymondley and towards Hitchin. The channel drains an upstream catchment area⁵ of approximately 13km which is predominantly rural but becomes more urban towards the site. The watercourse is culverted along the majority of its course through Little Wymondley.

OS mapping identifies a watercourse c.180m south of the site and flows in a south westerly direction to discharge into Ippollitts Brook. Ippollitts Brook joins the Ash Brook at a confluence c.1.9km northwest of the site.

Anecdotal evidence from the site walkover identifies a shallow ditch present along the northern boundary of Stevenage Road which intercepts runoff from land to the north (i.e., the site) and conveys this into the existing pond located to the south of the site. Flows from the pond overtop via a weir into a ditch present along Stevenage Road and then are discharged south via a culvert beneath the road and into a tributary of Ippollitts Brook.

There are no other significant hydrological features within 1km of the site.

2.3 Geology and Hydrogeology

2.3.1 Geology

The National Soils Resources Institute Soilscales website⁶ indicates that the natural soils on the site comprise of 'Slightly acid loamy and clayey soils with impeded drainage'.

Published geological mapping, by the British Geological Survey (BGS)⁷ indicates the bedrock geology at the site consists of the Holywell Nodular Chalk Formation and New Pit Chalk Formation (Undifferentiated) which is overlain by the Lowestoft Formation (Diamicton) and Glaciofluvial Deposits, Mid Pleistocene - Sand and Gravel around the existing pond in the south of the site and within the existing National Grid substation area to the west. Mapping of the superficial deposits is provided overleaf in Figure 2-2.

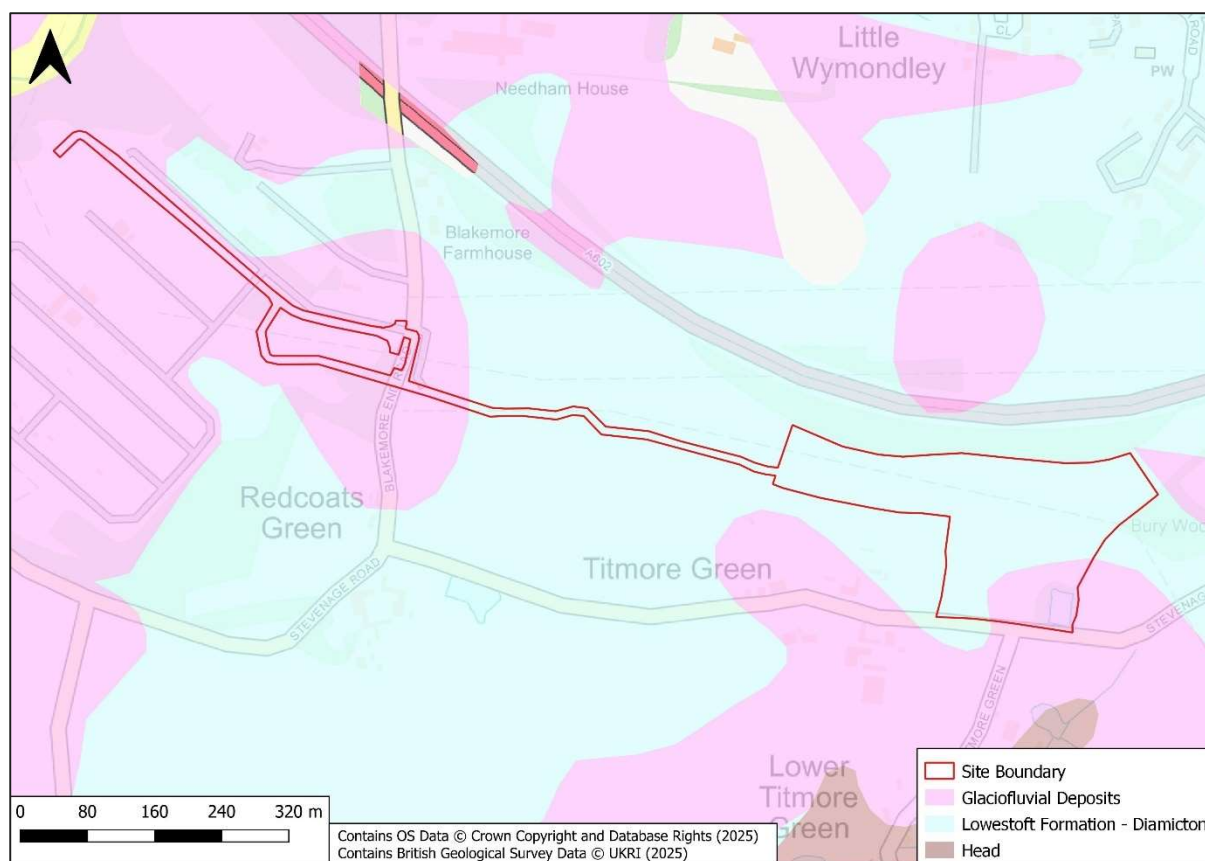
5 Flood Estimation Handbook Web Service, UK Centre for Ecology and Hydrology,
<https://fehweb.ceh.ac.uk/Map>

6 Soilscales online soil map, Cranfield Soil and Agrifood Institute, <http://www.landis.org.uk/soilscales/>

7 BGS website (Accessed May 2023) <http://mapapps.bgs.ac.uk/geologyofbritain/home.html>



Figure 2-2: Superficial Geology



Local borehole records on the site (Appendix B) logged as part of an intrusive investigation recorded the following generalised geology on the site.

Table 2-1: Observed Geological Sequence

Depth to base (m)	Geology
0.25 - 0.3	Topsoil
0.4 - 0.8	Glaciofluvial Deposits
2.5 – 3.2	Lowestoft Diamicton

2.3.2 Hydrogeology

The Holywell Nodular Chalk Formation and New Pit Chalk Formation is classified as a “Principal⁸” aquifer, defined as strategically important units that have high permeability, water storage capacity and may support water resources on a regional scale.

The Glaciofluvial deposits are classified as a “*Secondary A*” aquifer, defined as “permeable layers that can support water supplies locally and may form an important source of baseflow to rivers”.

The Diamicton deposits are defined as a “*Secondary (undifferentiated)*” aquifer, whereby it has not been possible to attribute A or B status and the designation is dependent on local lithology. Following a review of BGS borehole records (TL22NW83; 70m northwest of the

8 Magic Map Application, managed by Natural England, delivered by Landmark, <https://magic.defra.gov.uk/MagicMap.aspx>



site) indicates the Diamicton is predominantly clay with sandy and silty lenses. Groundwater seepage was noted in the sand and gravel lenses of the Diamicton, perched between clayey layers. Whilst this borehole is within the same mapped geology, given the highly heterogenous nature of the superficial deposits some variation in the proportion of the sandy and silty lenses would be expected.

2.3.3 Infiltration Testing

Infiltration testing following BRE 365 methodology was undertaken on the site between 07/08/2024 and 09/08/2024 by Southern Testing. A copy of their report is enclosed as Appendix B.

A total of 4 trial pits and soakage tests were undertaken however water was unable to drain to 25% depth in the first test and ultimately, all trial pits failed to drain away for completion of the testing in accordance with BRE 365.

2.4 Existing Drainage Regime

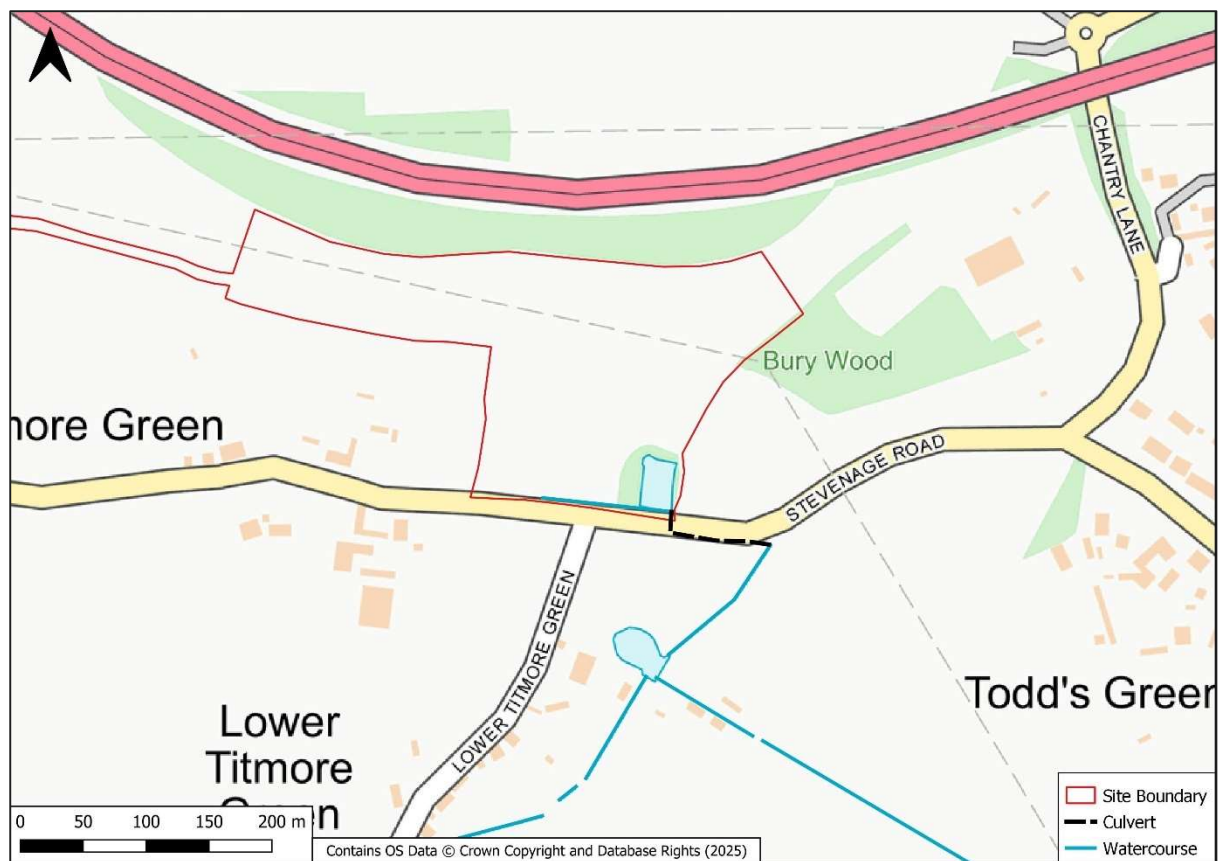
The site currently comprises greenfield land underlain by clayey shallow soils. Clayey soils have relatively low infiltration potential (as represented in the infiltration results) and, therefore, a relatively large proportion of rainfall does not discharge to ground and flows overland in line with the local topography to the south. Flows would then be intercepted by the surface water ditch along the northern boundary of Stevenage Road and conveyed eastwards into a culvert. This culvert conveys flows from within the ditch and excess flow from the pond beneath Stevenage Road into the tributary of the Ash Brook to the south.

Runoff from along the cable route within the National Grid substation area would continue west and into the Ash Brook.

Indicative mapping of the existing surface water drainage arrangement from the pond is shown below in Figure 2-3.



Figure 2-3: Existing Surface Water Drainage



3.0 Planning Policy and Guidance

3.1 Development Proposals

EDF-R is seeking planning permission for the construction and operation of a Battery Energy Storage System (BESS).

As detailed in Annex 3 of the NPPF¹, the proposed scheme is classified as an “*essential infrastructure*” development type associated with infrastructure for electricity supply including generation, storage and distribution systems; including electricity generating power stations, grid and primary substations.

3.1.1 Anticipated Lifetime of Development

In lieu of further information, an anticipated lifetime of 40-years is applied to this development (i.e., to 2065).

3.2 Flood Zone Classification

The definition of EA flood zones is provided in PPG *Table 1: Flood Zones*:

- **Zone 1 - Low Probability** (Flood Zone 1) is defined as land which could be at risk of flooding from fluvial or tidal flood events with less than 0.1% annual probability of occurrence (1:1,000 year) i.e., considered to be at ‘low probability’ of flooding.
- **Zone 2 - Medium Probability** (Flood Zone 2) is defined as land which could be at risk of flooding with an annual probability of occurrence between 1% (1:100 year) and 0.1% (1:1,000 year) from fluvial sources and between 0.5% (1:200 year) and 0.1% (1:1,000 year) from tidal sources i.e., considered to be at ‘medium probability’ of flooding.
- **Zone 3a - High Probability** (Flood Zone 3a) is defined as land which could be at risk of flooding with an annual probability of occurrence greater than 1% (1:100 year) from fluvial sources and greater than 0.5% (1:200 year) from tidal sources i.e., considered to be at ‘high probability’ of flooding.
- **Zone 3b - the Functional Floodplain** (Flood Zone 3b) This zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Functional floodplain will normally comprise:
 - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
 - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding).

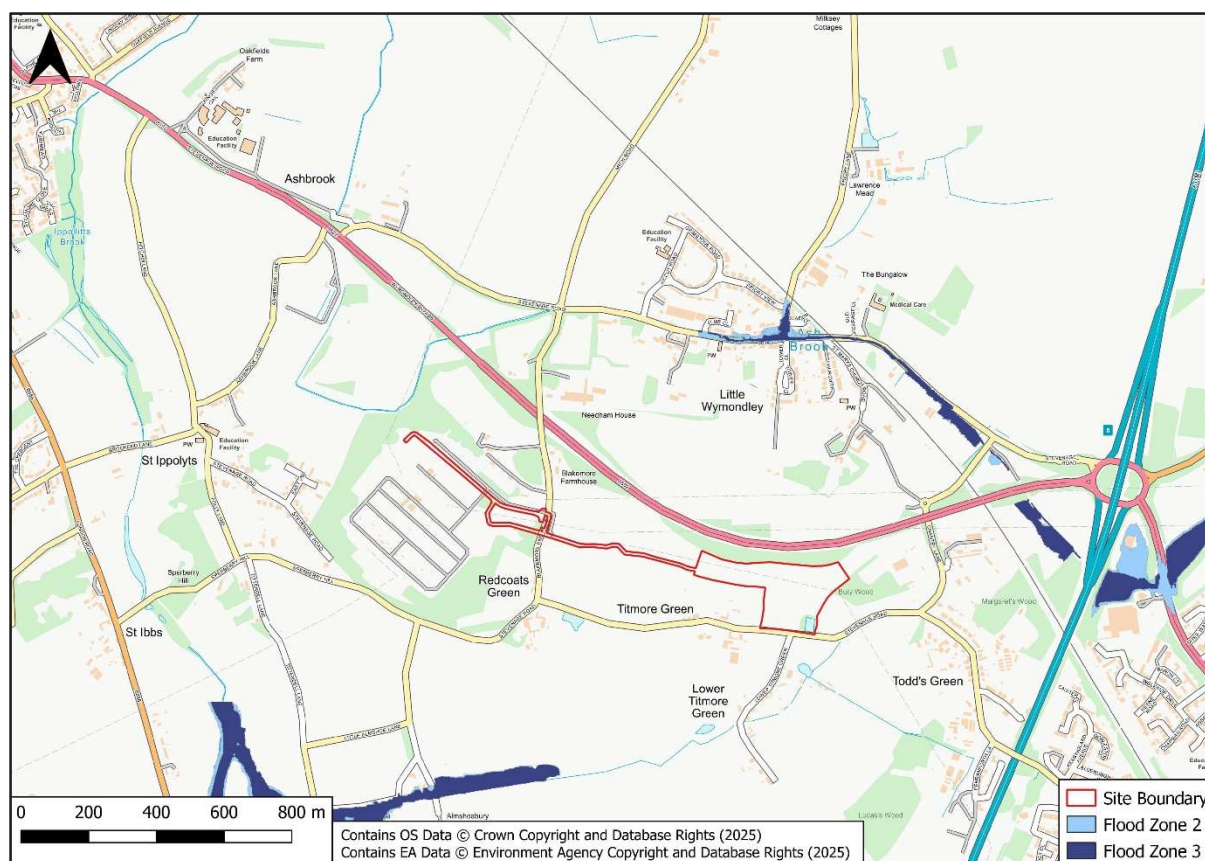
Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the EA. (Not separately distinguished from Zone 3a on the Flood Map)

In assessing the boundary between Flood Zones 1, 2 and 3, the protection afforded by any flood defence structures, and other local circumstances, is not considered by the EA.

An extract of the Flood Map for Planning is provided overleaf as Figure 3-1 and indicates that the site lies in an area designated as Flood Zone 1.



Figure 3-1: Extract of the Flood Map for Planning



3.3 National Planning Policy

This report has been completed in accordance with the guidance presented in the NPPF¹ and with reference to PPG².

3.3.1 Flood Risk Compatibility

As outlined in Table 3 of the PPG guidance² (reproduced as Table 3-1) '*Essential Infrastructure*' development types are considered appropriate within Flood Zone 1 and the exception test does not need to be applied.



Table 3-1: Flood Risk Vulnerability and Flood Zone Compatibility

Flood Risk Vulnerability Classification (PPG Table 2)		Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone (PPG Table 1)	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	Exception Test Required	✓	✓	✓
	Zone 3a	Exception Test Required	x	Exception Test Required	✓	✓
	Zone 3b (functional floodplain)	Exception Test Required	x	x	x	✓

Key: ✓ Development is appropriate x Development should not be permitted

3.3.2 Sequential Test

With reference to the NPPF¹, the Sequential Test gives preference to locating new development in areas that are at lowest risk of flooding (i.e., Flood Zone 1). The Environment Agency Flood Map for Planning (Figure 3-1) and SFRA are geared to providing the basis for applying this test.

The Sequential Test requires developers to:

“.....steer new development to areas with the lowest risk of flooding from any source. Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower risk of flooding. The strategic flood risk assessment will provide the basis for applying this test.

The sequential test should be used in areas known to be at risk now or in the future from any form of flooding, except in situations where a site-specific flood risk assessment demonstrates that no built development within the site boundary, including access or escape routes, land raising or other potentially vulnerable elements, would be located on an area that would be at risk of flooding from any source, now and in the future (having regard to potential changes in flood risk).”

The site lies in an area designated by the EA as Flood Zone 1 and therefore at very low risk of flooding from rivers and the sea. The Flood Risk Screening detailed in Section 4.0 confirms that the risk of flooding from all potential sources is very low and will remain very low throughout the anticipated lifetime of development.

On this basis, the sequential test is assumed to be passed.



3.4 Local Planning Policy

Determination of planning applications in Wymondley are the responsibility of North Hertfordshire District Council. The North Hertfordshire Local Plan⁹ sets the strategic vision and spatial strategy for the district from 2011 to 2031.

Relevant policy from the Local Plan is reproduced below.

Policy NE7: Reducing Flood Risk

Planning permission for development proposals will be granted provided that (as applicable):

- a) Development is located outside of medium and high-risk flood areas (flood zone 2 and 3) and other areas affected by other sources of flooding where possible;*
- b) Where (a) is not possible, application of the sequential and exception tests is demonstrated where development is proposed in areas of flood risk using the Strategic Flood Risk Assessment (SFRA) and Environment Agency flood maps;*
- c) A FRA has been prepared in accordance with national guidance that considers the lifetime of the development, climate change impacts and safe access and egress;*
- d) It will be located, designed and laid out to ensure the risk of flooding is reduced whilst not increasing flood risk elsewhere;*
- e) The impact of any residual flood risk will be minimised through flood resistant, resilient design and construction;*
- f) Any flood protection and mitigation measures necessary will not cause harm to nature conservation, heritage assets, and/ or landscape and recreation and, where possible, will have a positive impact in these respects; and*
- g) Overland flow routes and functional floodplain areas are protected from all development other than that which is “water compatible” and this must be designed and constructed to remain operational and safe for users during flood events, resulting in no net loss of flood plain storage and not impeding water flows or increasing flood risk elsewhere.*

3.5 Climate Change

In February 2016, the Environment Agency issued updated guidance on the impacts of climate change on flood risk in the UK to support NPPF¹⁰. This advice, which was most recently updated in May 2022, sets out that peak rainfall intensity, sea level, peak river flow; offshore wind speed and extreme wave heights are all expected to increase in the future as a result of climate change. Consideration of the changes to these parameters should use the allowances outlined below based on the anticipated lifetime of the development.

The site is remote from the coast and therefore changes relating to sea level, wave heights and wind speed are not applicable. The site is located in Flood Zone 1 and remote from any rivers. Changes in peak fluvial flow are therefore also not applicable

Changes to peak rainfall are the only applicable parameter to this assessment and could alter surface water flooding and the provision of drainage.

9 North Hertfordshire Local Plan, 2011-2031, North Herts Council, <https://www.north-herts.gov.uk/sites/default/files/2022-12/North%20Hertfordshire%20Local%20Plan%202011-2031.pdf>

10 Environment Agency, Flood Risk Assessments: Climate change allowances. February 2016, Updated July 2021



The guidance acknowledges that there is considerable uncertainty with respect to the absolute level of change that is likely to occur. As such, the document provides estimates of possible changes that reflect a range of different emission scenarios.

3.5.1 Peak Rainfall Intensity

For peak rainfall intensity the PPG guidance states that flood risk assessments should assess both the '*central*' and '*upper end*' allowances to understand the range of impacts. For development with a lifetime between 2061 and 2125, the 2070's epoch should be used. This assessment will conservatively use the Upper End allowances for the assessment of flood risk and drainage design standard.

As detailed in Table 3-2, these equate to uplifts of 35% and 40% for the 3.3% AEP and 1% AEP respectively.

Table 3-2: Peak Rainfall Intensity Allowance in Small and Urban Catchments

River Basin District	Allowance Category	AEP (%)	Total potential change anticipated for 2050s	Total potential change anticipated for 2070s
Upper and Bedford Ouse	Upper End	3.3	35%	35%
	Central		20%	25%
	Upper End	1	40%	40%
	Central		20%	25%



4.0 Potential Sources of Flooding

4.1 Screening Study

Potential sources of flooding include:

- Flooding from the sea or tidal flooding;
- Flooding from rivers or fluvial flooding;
- Flooding from surface water and overland flow;
- Flooding from groundwater;
- Flooding from sewers;
- Flooding from reservoirs, canals, and other artificial sources; and
- Flooding from infrastructure failure.

The flood risk from each of these potential sources is discussed below and summarised in Table 4-1.

4.2 Methodology and Best Practice

This FRA report has been prepared in accordance with the advice and requirements prescribed in current best practice documents relating to management of flood risk in development published by the Construction Industry Research and Information Association (CIRIA)¹¹, and British Standard BS8533³.

A screening study has been completed to identify whether there are any potential sources of flooding at the site which may warrant further consideration. If required, any potential significant flooding issues identified in the screening study are then considered in subsequent sections of this assessment.

4.2.1 Flooding from the Sea or Tidal Flooding

The site is located remote from the coast and elevated to over 90m aOD.

The risk of flooding from the sea or tidal sources is negligible and not considered further.

4.2.2 Flooding from Rivers or Fluvial Flooding

The Flood Map for Planning reproduced as Figure 3-1 indicates the site lies in an area designated as Flood Zone 1 and there are no watercourses close to the site. Therefore the site is at very low risk of flooding from rivers and fluvial sources.

On this basis, the risk of flooding from rivers or fluvial sources is very low and not considered further.

4.2.3 Flooding from Surface Water and Overland Flow

Conceptually, due to the presence of an embankment immediately north of the site, there is limited upgradient catchment area for surface water runoff to discharge towards the BESS area. Review of LiDAR data suggests the presence of a ditch along the northern boundary of Stevenage Road which is likely to capture overland flow following rainfall events, conveying flows east towards the pond and culvert inlet.

¹¹ CIRIA Report C624, Development and flood risk: guidance for the construction industry



Long Term Flood Risk Information (LTFRI)¹² provided by the Environment Agency includes mapping of surface water flood risk. Surface water modelling has been undertaken by the Environment Agency in order to establish areas at risk of surface water flooding based upon latest hydrological techniques and surface terrain data.

An extract of the map for the site and surrounding area is presented in Figure 4-1, where the Environment Agency define the surface water flood risk categories as:

- **Very Low:** less than 1 in 1,000 annual probability of flooding in any given year;
- **Low:** less than 1 in 100 annual probability but greater than or equal to 1 in 1,000 annual probability of flooding in any given year;
- **Medium:** between 1 in 100 annual probability and 1 in 30 annual probability of flooding in any given year; and
- **High:** greater than 1 in 30 annual probability of flooding in any given year.

The mapping below indicates that the majority of the site is at very low risk of surface water flooding. Areas of elevated risk (low and medium) are present along the northern boundary of Stevenage Road corresponding to the ditch, as well as ponding along the western boundary of the pond which overtops onto Stevenage Road. In reality, flow from this pond discharges via a culvert beneath the road reducing the likelihood of overtopping. Areas of surface water ponding would also be reduced due to the provision of surface water drainage on the site. These isolated areas are outside of the current proposed BESS extent and therefore not problematic to the development.

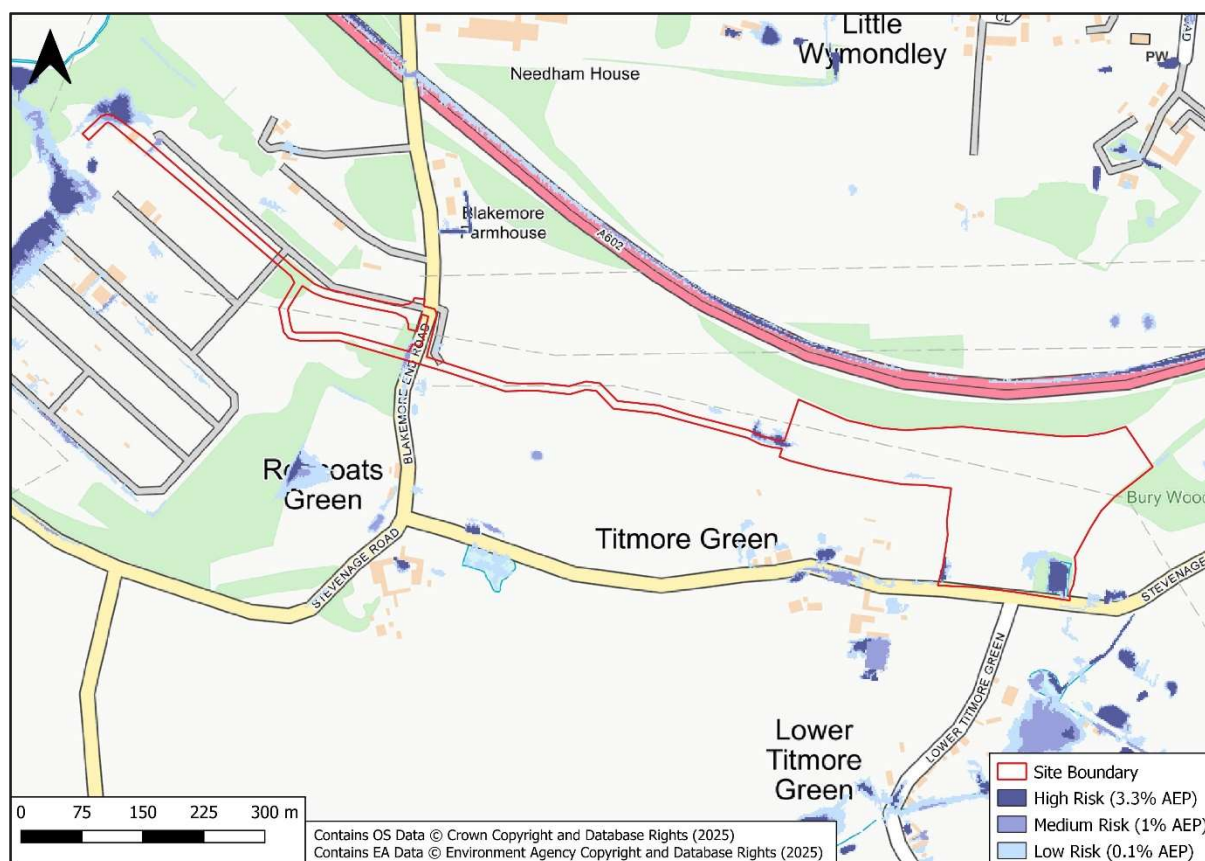
Areas of risk are also present along the cable route in the west. The cable route will be water-compatible and buried beneath the ground. Any surface flooding will not have any adverse impact to the cable route. Ground levels along the route will be reinstated as existing having no impact on surface water flood risk.

On this basis, the risk of flooding from surface water and overland flow to the development is very low and not considered further.

12 Environment Agency, Long Term Flood Risk Information Service: <https://flood-warning-information.service.gov.uk/long-term-flood-risk/map>



Figure 4-1: EA Surface Water Flood Map



4.2.4 Flooding from Groundwater

Groundwater flooding can be defined as flooding caused by the emergence of water originating from subsurface strata. Groundwater flooding can occur where sites are located on permeable ground. After a prolonged period of rainfall and groundwater recharge, a considerable rise in the water table can result in inundation for extended periods of time.

BGS mapping indicates that the site is located on a principal aquifer overlain by mixed permeability geology which, as identified in local borehole records, is largely clay based and up to 8m thick. Whilst shallow groundwater is noted in permeable lenses in local boreholes, this is not consistent across the diamicton deposit, and these lenses are typically poorly connected with insufficient groundwater catchment to result in flooding. No groundwater was recorded in any of the trial pits excavated during the site investigation (Appendix B).

Groundwater flooding is considered to be very low and subsurface development associated with the cable route corridor and associated infrastructure would be designed to be water resilient and would therefore not be impacted by shallow groundwater flow or infiltration/percolation. The risk of groundwater flooding to the development is not considered further.

4.2.5 Flooding from Sewers and Water Mains

Anglian Water Asset Plans contained in Appendix C identifies a foul sewer present about 250m to the east of the site at the junction between Stevenage Road and Chantry Lane. In the event of failure of the foul sewer, flows would discharge along Stevenage Road to the west and into the watercourse to the south of Stevenage Road and away from the site.

Affinity Water Asset Plans contained as Appendix D indicate a distribution main immediately to the west of the existing site access track. Failure or burst of this system would result in



flows discharging south away from the BESS area and progressing east along Stevenage Road and into the watercourse to the south.

Affinity Water Asset Plans also identify an asbestos distribution main orientated northeast to southwest through the site. Failure or burst of this network would result in flows progressing south away from the site towards the existing pond, Stevenage Road and into the watercourse to the south.

No flooding of the proposed development area is predicted as a result of failure or burst of any sewer or mains system locally. Flooding from this source is therefore not considered further.

4.2.6 Flooding from Reservoirs, Canals and Other Artificial Sources

EA Reservoir Breach mapping¹³ indicates that the site is not located in an area at risk of flooding from reservoirs. Additionally, there are no canals in the vicinity of the site, failure of which may result in flooding.

Mapping of the existing drainage in Figure 2-3 identifies a culvert from the pond beneath Stevenage Road into a tributary of the Ash Brook. In the event of blockage or surcharge flows would overtop onto Stevenage Road and discharge south into the southern watercourse. This would require a flood level of approximately 90.5m aOD. All sensitive infrastructure will however be sited on land above 90.5m aOD and therefore the prevailing risk is low.

Flooding from reservoirs, canals and other artificial sources is very low and not considered further.

4.2.7 Flooding from Infrastructure Failure

The site is not afforded protection from flood defences, and with reference to OS mapping, the site is also not located in the vicinity of a pumping station.

Flooding from Infrastructure Failure is negligible and not considered further.

4.3 Summary of Flood Screening

Table 4-1 below summarises the flood screening assessment.

Table 4-1: Summary of Flood Screening

Potential Source	Potential Significant Flood Risk at Site?
Sea or Tidal Flooding	No
Rivers or Fluvial Flooding	No
Surface Water and Overland Flow	No
Groundwater	No
Sewers and Water Mains	No
Reservoirs, Canals and other Artificial Sources	No

¹³ Environment Agency Risk of Flooding from Reservoirs - Maximum Extent Flood Map



Potential Source	Potential Significant Flood Risk at Site?
Infrastructure Failure	No



5.0 Surface Water Drainage Strategy

This surface water drainage strategy sets out high level principles for managing storm water on the site in line with best practice and the requirements of Hertfordshire County Council, the Lead Local Flood Authority for the area. The strategy has been produced in support of the planning application.

This outline drainage strategy is intended to demonstrate that it will be feasible to drain the site in line with planning requirements.

This report has been informed following a pre-app to Hertfordshire County Council LLFA (Preapp/2025/NHDC/02).

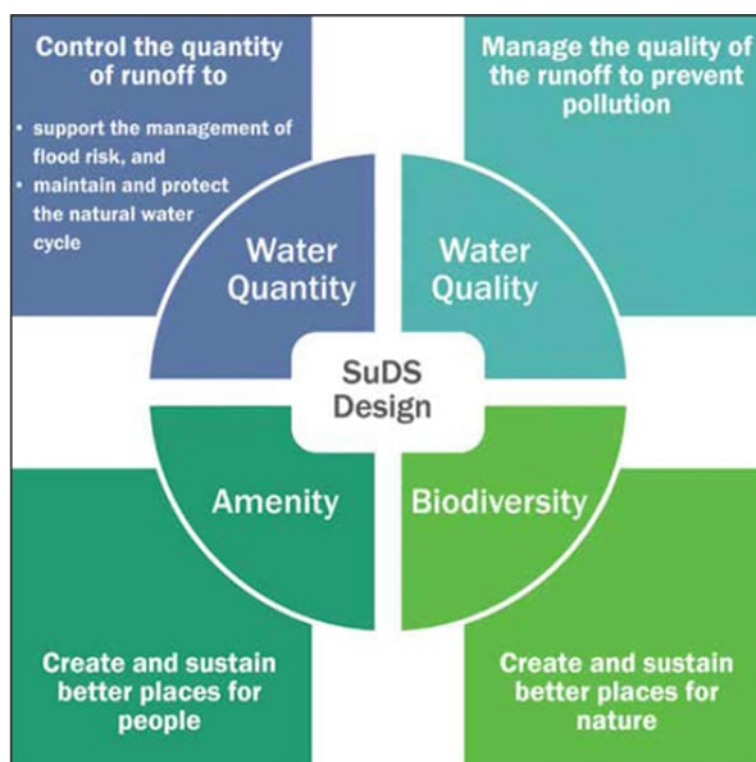
The Hertfordshire County Council SuDS Proforma is attached as Appendix E.

5.1 Key Principals of Surface Water Management

5.1.1 Overview

Current best practice guidance document: The Sustainable Drainage System (SuDS) Manual (CIRIA Report C753)¹⁴, promotes sustainable water management through the use of SuDS. There are four main categories of SuDS which are referred to as the ‘four pillars of SuDS design’ as depicted in Figure 5-1.

Figure 5-1: Four Pillars of SuDS (extract from CIRIA Report C753)



The SuDS Manual identifies a hierarchy of SuDS for managing runoff, which is commonly referred to as a ‘management train’. The hierarchy of techniques is identified as:

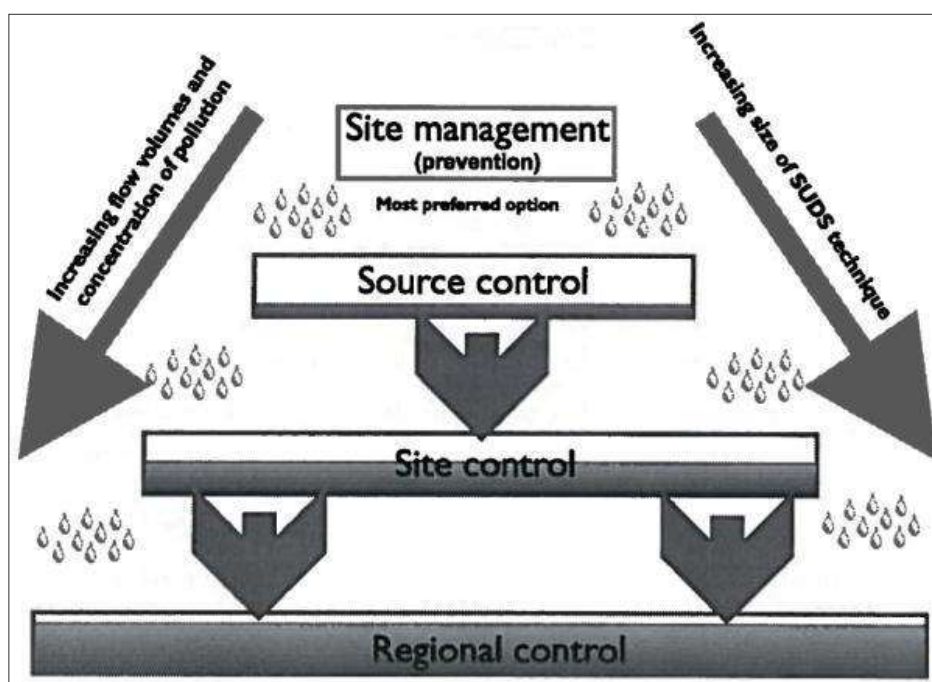
- Prevention – the use of good site design and housekeeping measures on individual sites to prevent runoff and pollution (e.g. minimise areas of hard standing).

14 Report C753, The SuDS Manual; CIRIA (2015). Report C753, November 2015.



- Source Control – control of runoff at or very near its source (such as the use of rainwater harvesting).
- Site Control – management of water from several sub-catchments (including routing water from roofs and car parks to one/several large soakaways for the whole site).
- Regional Control – management of runoff from several sites, typically in a retention pond or wetland.

Figure 5-2: SuDS Management Train



It is generally accepted that the implementation of SuDS, as opposed to conventional drainage systems, provides a number of benefits by:

- Reducing peak flows to watercourses or sewers and potentially reducing the risk of flooding downstream;
- Reducing the volumes and frequency of water flowing directly to watercourses or sewers from developed sites;
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources;
- Reducing potable water demand through rainwater harvesting;
- Improving amenity through the provision of public open spaces and wildlife habitat; and replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.

5.1.2 National Policy Context

Current national planning policy guidance and best practice, namely NPPF and PPG, require development proposals in all Flood Zones to seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of SuDS.



5.1.3 Local Policy Context

Herefordshire County Council in their role as the LLFA have developed a LLFA Summary Guidance for developers in relation to the management of surface water drainage¹⁵ which should be adhered to for planning applications. Relevant text is reproduced below:

Runoff Rates

Peak discharge rates from site will not increase as a result of the proposed development, up to a 1 in 100 chance in any year including an allowance for climate change storm event. We expect all applicants to achieve greenfield runoff rates for greenfield development sites and to aim to provide greenfield run-off rates for all brownfield sites to reduce the impact of the development on the surface water drainage infrastructure.

Storage Volumes

Storage volumes for all events up to a 1 in 100 chance in any year including an allowance for climate change storm event will be provided on site utilising above ground storage where practicable.

The site will not flood from surface water up to a 1 in 100 chance in any year including an allowance for climate change event, OR surface water flooding will be safely contained on site up to this event, ensuring that surface water runoff will not increase flood risk to the development or third parties. There should be no flooding within the site for up to and including the 1 in 30 chance in any year rainfall event.

Sustainable Drainage Techniques

Sustainable Drainage Systems (SuDS) such as green roofs, attenuation basins, ponds, swales and permeable pavements will be used.

SuDS are an approach to managing surface water runoff which seeks to mimic natural drainage systems and retain water on or near the site as opposed to traditional drainage approaches which involve piping water off site as quickly as possible. SuDS offer significant advantages over conventional piped drainage systems in reducing flood risk by attenuating the rate and quantity of surface water runoff from a site, promoting groundwater recharge and biodiversity benefits, as well as improving water quality and amenity value.

The SuDS hierarchy should be followed as you design the site. The methods at the top of the hierarchy are preferred because they are beneficial in terms of sustainability, water quality and biodiversity. The hierarchy should be used in descending order, with any obstacles to the use of SuDS methods clearly justified. If the 'lack' of space is given as a reason for not implementing SuDS we will require evidence that an alternative layout and consideration of other SuDS techniques has been considered. If the 'cost' is given as a reason for not implementing SuDS system evidence should be provided to the LPA.

Residual Risk

The residual risk of flooding can be managed and contained safely on site should any drainage features fail (e.g., pumps, flow controls or Hydro-Brakes) OR during an extreme storm event. The location and depth and flow routes of any over ground flooding should be clearly shown on a plan.

Infiltration Rates

Infiltration rates should be worked out in accordance with BRE Digest 365 for shallow infiltration and Falling Head tests for deep bore infiltration. If it is not feasible to access the site

¹⁵ Hertfordshire County Council (2021), LLFA Summary Guidance for developers, Management of Surface Water Drainage, Available at: <https://www.hertfordshire.gov.uk/media-library/documents/environment-and-planning/water/surface-water-drainage/guidance-for-developers.pdf>



to carry out soakage tests before planning approval is granted, a desktop study could be undertaken looking at the underlying geology of the area, however, experience has shown that these should not be used for site specific analysis. We will therefore require you to assume a worst-case infiltration rate for that site and provide a feasible alternative drainage scheme which gives priority to above ground SuDS techniques.”

5.2 Existing Surface Water Drainage Regime

The site currently comprises of greenfield land underlain by clayey shallow soils. Clayey soils will reduce infiltration potential to ground (as represented in the infiltration results) and therefore only a small proportional of rainfall will discharge to ground and a large proportion will flow overland in line with the local topography to the south. Flows would then be intercepted by the surface water ditch along the northern boundary of Stevenage Road and conveyed towards the outlet of the pond and into a culvert. This culvert conveys flows from within the ditch and excess flow from the pond beneath Stevenage Road into the tributary of the Ash Brook to the south.

5.2.1 Pre-Development Runoff Rates (Greenfield)

Greenfield runoff rates for the site have been estimated through application of the Revitalised Flood Hydrograph Model (ReFH2). ReFH2 is recommended by the EA as the methodology for estimating flood peaks and hydrographs for small catchments¹⁶. The ReFH2 method is applied using software ‘The Revitalised Flood Hydrograph’ modelling tool.

The FEH parameters have been reviewed with understanding of the local geological context and are considered to be appropriate.

The greenfield runoff results are summarised in Table 5-1 and full results are included as Appendix F.

Table 5-1: Greenfield Runoff Rates

Annual Probability	Greenfield Runoff Rate (l/s/ha)	Drained Area Runoff Rate (l/s/0.876ha)
100%	0.9	0.8
50%	1.0	0.9
3.3%	2.4	2.1
3.3% + 35% CC	3.4	3.0
1%	3.1	2.7
1% + 40% CC	4.6	4.0

16 Environment Agency, Estimating flood peaks and hydrographs for small catchments: Phase 1, Project: SC090031, May 2012



5.3 Constraints on the Use of SuDS

5.3.1 Geology

The site is underlain by glaciofluvial deposits which, following a review of local borehole records, predominantly comprise of clay and sands. Infiltration testing has been undertaken on the site and the outputs from the testing are provided as Appendix B. The testing failed to achieve a successful test to BRE 365 in any of the trial pits and extrapolation of rates derived values below the $1 \times 10^{-6} \text{m/s}$ minimum threshold value in which a soakaway can be classified as efficient.

Infiltration of surface water runoff to ground is not considered to be a feasible method of discharge at the site.

5.3.2 Topography

Ground levels across the site fall in a southerly direction towards Stevenage Road. SuDS features should be preferentially located on land downgradient of the site but upgradient of the discharge receptor so that surface water runoff can drain via gravity. As discussed in Section 5.3.1, infiltration of surface water runoff to ground is not achievable. Following a review of site hydrology, there is an existing surface water ditch and pond along the southern site boundary by which flow is conveyed via a culvert beneath Stevenage Road to the southern ditch. This is the current receptor for surface water runoff from the site and is downgradient of the proposed BESS area.

5.3.3 Biodiversity and Amenity

In line with SuDS principals, the amenity and biodiversity of SuDS has been considered within the drainage design. Flows which are shed from the compound will discharge into a large SuDS detention basin. The detention basin has been designed with a shallow side gradient (1 in 4) and these margins would be planted up with appropriate aquatic vegetation.

5.4 Proposed Discharge Arrangement

With reference to the SuDS Manual, the hierarchy of preferred disposal options for surface water runoff from development sites in decreasing order of sustainability is as follows:

1. Infiltration to Ground;
2. Discharge to Surface Waters; or
3. Discharge to Sewer.

Table 5-2 summarises the suitability of disposal methods suitability in the context of the site and the proposed development.

Table 5-2: Suitability of Surface Water Disposal Methods

Surface Water Disposal Method (in order of preference)	Suitability Description	Method Suitable? (Y / N)
Infiltration to Ground	Infiltration testing undertaken on the site (Appendix B) demonstrates that the site failed to drain in line with BRE 365 and this is therefore not a feasible discharge receptor.	N



Surface Water Disposal Method (in order of preference)	Suitability Description	Method Suitable? (Y / N)
Surface Water Discharge	A tributary of the Ash Brook is present to the south of Stevenage Road which receives surface water runoff from the existing pond via a culvert beneath Stevenage Road. The pond and subsequently Ash Brook tributary are the existing receptors for surface water runoff from the site.	Y
Sewer Discharge	Anglian Water Sewer Plans contained in Appendix C indicate that there are no surface water sewers in the vicinity of the site. Alternatively, the mapping identifies a foul sewer to the east of the site at the Chantry Lane / Stevenage Road junction. Preliminary discussions with Anglian Water suggest this is not an acceptable approach.	N
Private Drainage	A GPR Survey has been undertaken at the National Grid site to the west; this is provided as Appendix G. The survey identifies a surface water manhole along the access road to the substation which discharges via a 150mm pipe into the Ash Brook. Connection could be established however this would require surface water to be pumped upgradient and agreement from National Grid.	Y

5.5 Surface Water Drainage Strategy

The proposed drainage strategy will manage surface water runoff as close to the source as possible and within the confines of the site for the 1% AEP event plus a 40% accommodation for climate change throughout the 40-year anticipated lifetime of development, as discussed in Section 3.5.1.

It is envisaged that development of the site will involve scraping back the topsoil and overlaying the site with a permeable aggregate / stone (generally single sized). This would form a gravelled compound area (30% void space) fully within the confines of the security fencing. The battery units and ancillary equipment will be located within the gravelled area on concrete plinths.

Surface water falling on the aggregate / stone areas and water that is shed from the power units / concrete plinth areas will percolate through the gravel subbase into perforated pipes. Flow within the perforated pipes would be conveyed to a swale for attenuation and filtration. Runoff from the swale will be restricted to 1l/s, which is the minimum practicable rate and will discharge into the existing pond to the south of the site, which outfalls into the watercourse to the south of Stevenage Road. Whilst greenfield rates are below this for the 100% and 50%



AEP, restricting rates below this would significantly increase the risk of blockage and subsequent flooding.

The existing pond is the existing receptor for surface water runoff at the site and water levels are controlled by the Stevenage Road culvert. Whilst surface water could be routed to the ditch, runoff routed into the existing pond will ensure that there is no reduction in flow entering the system and should therefore remain a permanent body of water and support the existing biodiversity.

The SuDS pond is designed to have 1:4 side slopes and will be planted with appropriate vegetation to enhance biodiversity and amenity benefits. A penstock will be placed on the outfall to the SuDS pond in the event of firewater contamination, thus preventing runoff entering the wide water environment.

A conceptual surface water drainage strategy drawing is provided as Appendix H.

5.6 Proposed Catchment Area Schedule

For the purposes of the drainage calculations, the proposed areas 'contributing' runoff to the drainage network were assessed from the development proposals plan (refer to Appendix A).

It is assumed that all proposed development areas, including the gravels overlain to form the compound and the detention basin, will be effectively impermeable.

5.7 SuDS Assessment of Drainage

Temporary storage volumes were estimated using Flow+¹⁷; an appropriate methodology for Planning and Masterplanning purposes.

The FEH22 rainfall model was used with a design standard return period of 1% AEP (1 in 100-year return period) plus an allowance for climate change as recommended within NPPF (applied as a 40% uplift in peak rainfall intensity).

Full model details and calculation results of are provided as Appendix I and predicts no flooding at the site for events up to and including the 1% AEP plus 40% climate change rainfall.

5.7.1.1 SuDS Performance

The proposed swale will provide attenuation and filtration of stormwater runoff prior to discharge into the existing pond. Comparison between the pre and post development runoff rates are summarised per rainfall event in Table 5-3.

Table 5-3: Comparison of Pre and Post Development Runoff Rates

Annual Exceedance Probability Event (%)	Drained Area Runoff Rate (l/s)	Post Development Runoff Rate (l/s)	Reduction in Runoff Rate	
			l/s	%
50	0.9	0.9	-	
3.3	2.1	0.9	1.2	57
1	2.7	0.9	1.8	67

17 Flow+ v10.6.234, Causeway Technologies Ltd, Copyright 1988-2024



Annual Exceedance Probability Event (%)	Drained Area Runoff Rate (l/s)	Post Development Runoff Rate (l/s)	Reduction in Runoff Rate	
			l/s	%
1 +40% CC	4.0	1.0	3.0	75

The proposed drainage strategy offers a reduction of up to 75% in runoff rates in comparison to the existing / future baseline scenario.

Comparison between the pre and post development 6-hour runoff volumes are summarised per rainfall event in Table 5-4. Data provided in Table 5-4 below indicates a reduction in runoff 6-hour volumes by up to 57% from the existing regime. A small increase in discharge volume (11.3m³) is predicted for the 50% AEP. We would note that the modelling does not consider any losses to through interception or evaporation and therefore the likely discharge volume is smaller than this. The additional 11.3m³ over a 6-hour period is not considered to detrimentally impact flood risk locally.

Table 5-4: Comparison of Pre and Post Development Runoff Volumes

Annual Exceedance Probability Event (%)	Drained Area 6-hour Runoff Volume (m ³)	Post Development 6-hour Runoff Volume (m ³)	Reduction in Runoff Volume	
			m ³	%
50	16.2	27.5	-	
3.3	37.4	28.1	9.3	25
1	48.1	29.4	18.7	39
1 +40% CC	73.5	31.7	41.8	57

5.7.2 Residual Risk

5.7.2.1 Blockage

As discussed in Section 5.1.3, Herefordshire County Council require an assessment of the residual flood risk in the event of failure or blockage of flow control devices.

Modelling has been undertaken of the residual risk by assuming no outflow (i.e., blockage) for the duration of the storm event. This is however considered extremely conservative as this assumes that the device is blocked at the start of the storm when in reality this would be checked during routine maintenance. Additionally, during most blockages at least some water continues to be able to pass through the system.

The model outputs are provided as Appendix J and only predicts flooding during the critical 1% AEP plus 40% climate change event for durations up to and beyond 960 mins (16 hours). These flood flows would discharge to the south and into the pond, mimicking the existing regime.

The Pre-app response from HCC states there is a requirement for modelling the SuDS features with a surcharged outfall. The modelling undertaken of residual risk is considered a sufficient and conservative representation of this. In reality, the swale is raised (min elevation of 92.5m aOD) well above the pond height (90.5m aOD) and therefore the pond would be continuously overtopping into the downstream ditch before discharge from the SuDS feature was restricted.



5.7.2.2 Firewater Contamination

The surface water drainage system will be fitted with a penstock at the outfall to prevent contaminated water entering the larger network in the event of a storm. The clayey nature of the strata to a minimum thickness of 3.2m (as confirmed in the infiltration testing) is considered to be a sufficient barrier to allowing water to discharge into the underlying aquifer. No additional measures to prevent water discharging to ground are considered necessary.

Modelling has been undertaken to assess the impact of a fire and discharge of firewater at the beginning of a 7-day 1 in 10-year rainfall event. It is envisaged that the volume of water required for firewater storage is 223m³. Outputs of this modelling are provided in Appendix K which indicates that the 7-day 1 in 10-year rainfall event with no outflow corresponds to 616m³ of stormwater storage with an available on-site capacity of 1247m³. This therefore means there is 631m³ of storage available for firewater and as such is well in excess of the 223m³ required.

5.8 SuDS Assessment of Water Quality

SuDS provide a number of water quality benefits, and the proposed surface water management uses a gravel compound and swale for attenuation of flows prior to discharge. It is assumed that the gravel compound will provide the pollution hazard indices equivalent to a french drain.

The simple index method, as outlined within the SuDS Manual, provides a way of quantifying the benefit to water quality of the SuDS Management Train. The pollution hazard from the land use and the mitigation from the SUDS component are each assigned an index. The total mitigation index must be greater than the pollution hazard index for adequate treatment to be delivered.

Total SuDS mitigation index ≥ pollution hazard index
(for each contaminant type) (for each containment type)

The total SUDS mitigation is the summation of the first components mitigation index and half the mitigation index of any subsequent component.

With reference to the SuDS Manual, post-development surface water runoff generated from is considered to have a '*Low*' *Pollution Hazard Level* respectively as presented in Table 5-5.

Table 5-5: Pollution Hazard Potential of the Proposed Development

Land Use	Pollution Hazard Level	Pollution Hazard Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Battery Storage Facility (site with infrequent traffic movements)	Low	0.5	0.4	0.4

The proposed drainage system is required to demonstrate sufficient treatment capability to manage the specified Pollution Hazard Indices. The SuDS mitigation indices for the Proposed Development is provided in Table 5-6.



Table 5-6: SuDS Mitigation Indices for the Proposed Development

Discharge Receptor	SuDS Component	Mitigation Indices		
		Total Suspended Solids (TSS)	Metals	Hydro-Carbons
Surface water	Gravel Compound (French Drain)	0.4	0.4	0.4
	Swale	0.5	0.6	0.6

Table 5-7 compares the SuDS Mitigation Indices, provided by the proposed 'Source Control', 'Conveyance' and 'Site Control' measures against the Pollution Hazard Indices.

Table 5-7: SuDS Performance: Water Quality Indices

Land Use	Pollution Hazard Level	Pollution Hazard and SuDS Mitigation Indices Comparison					
		Total Suspended Solids (TSS)		Metals		Hydro-Carbons	
		Pollution Index ¹	SuDS Mitigation Index	Pollution Index ¹	SuDS Mitigation Index	Pollution Index ¹	SuDS Mitigation Index
Discharge to Surface water: Battery Storage Facility	Low	0.5	0.65	0.4	0.7	0.4	0.7

1. Mitigation indices = (1 x french drain index) + (0.5 x swale index) to account for primary and secondary components in the drainage scheme. A factor of 0.5 is used to account for the reduced performance of the secondary component (detention basin).

As the SuDS Mitigation Index provided by the proposed SuDS measures are $\geq$ Pollution Hazard Index the water quality assessment criteria are satisfied for the site.

5.9 SuDS Operation and Maintenance

A full SuDS maintenance plan would be produced as part of the detailed drainage design post-development and the precise requirement would depend on manufacture specification of the final design. At this time, it is considered that the maintenance of the drainage network would be the responsibility of the site owner and / or operator.

An outline of the typical maintenance requirements of each proposed SuDS feature is provided below.

5.9.1 Gravel Compound

The anticipated maintenance and management for the gravel compound associated with the surface water drainage system is outlined in Table 5-8.



Table 5-8: Typical Gravel Compound Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter (including leaf litter) and debris from surface, access chambers and pre-treatment devices	Monthly, or as required
	Inspect gravel surface, inlet/outlet pipework and control systems for blockages, clogging, standing water and structural damage	Monthly
	Inspect pre-treatment systems, inlets, and perforated pipework for silt accumulation, and establish appropriate silt removal frequencies	Six monthly
	Remove sediment from pre-treatment devices	Six monthly, or as required
	Remove sedimentation that has become entrained into the outflow	Every 6 months
Occasional Maintenance	Remove or control tree roots where they are encroaching the sides of the filter drain, using recommended methods (e.g., NJUG, 2007 or BS 3998:2010)	As required
	At locations with high pollution loads, remove surface geotextile and replace, and wash or replace overlying filter medium	Five yearly, or as required
	Clear perforated pipework of blockages	As required

5.9.2 Swale

The anticipated maintenance and management for the Swale associated with the surface water drainage system is outlined in Table 5-9.

Table 5-9: Typical Swale Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove litter and debris	Monthly, or as required
	Cut grass – to retain grass height within specified design range	Monthly (during growing season), or as required
	Manage other vegetation and remove nuisance plants	Monthly at start, then as required
	Inspect inlets, outlets and overflows for blockages, and clear if required	Monthly
	Inspect infiltrations surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48 hours	Monthly, or as required.
	Inspect vegetation coverage	Monthly for 6 months, quarterly for 2 years, then half yearly



Maintenance Schedule	Required Action	Minimum Frequency
	Inspect inlets and facility surface for silt accumulation, establish appropriate silt removal frequencies	Half yearly
Occasional maintenance	Reseed areas of poor vegetation growth, alter plant types to better suit conditions, if required	As required or if bare soil is exposed over 10% or more of the swale treatment area
Remedial Actions	Remove or control tree roots where they are encroaching the sides of the crates, using recommended methods (e.g. NJUG, 2007 or BS 3998:2010). Clear silt and debris from the ditch to ensure correct operation.	As required.
	Relevel uneven surfaces and reinstate design levels	
	Scarify and spike topsoil layer to improve infiltration performance, break up silt deposits and prevent compaction of the soil surface	
	Remove build-up of sediment on upstream gravel trench, flow spreader or at the top of filter strip	
	Remove and dispose of oils or petrol residues using safe standard practices	

5.9.3 HydroBrake

The anticipated maintenance and management for the HydroBrake associated with the surface water drainage system is outlined in Table 5-10.

Table 5-10: Typical HydroBrake Maintenance Requirements

Maintenance Schedule	Required Action	Minimum Frequency
Regular Maintenance	Remove sedimentation that has become entrained into the HydroBrake outflow	Every 6 months
Occasional Maintenance	Periodic measuring of the HydroBrake bore size	Every 3 years
	Checking of the hydro-brake for leakage issues	Annually

5.10 Exceedance

In the low probability event of exceedance of the site drainage strategy, surface water would overtop the swale and discharge towards Stevenage Road / existing pond to the south of the site. Mimicking the existing regime, once the existing pond was overtopped, flows would overtop onto and across Stevenage Road, discharging into the watercourse to the south of the road and away from the site.



6.0 Conclusions

SLR Consulting Limited has been appointed by Pivoted Power LLP (part of EDF Energy Renewables Ltd) to prepare a Flood Risk Assessment (FRA) and Surface Water Drainage Strategy (SWDS) for a proposed Battery Energy Storage System (BESS) on land off Stevenage Road, Ashbrook, Little Wymondley, Hertfordshire, SG4 7JL.

6.1 Flood Risk

Flood risk has been assessed in line with BS8533³ taking account of national and local planning policy and guidance, and all potential sources of flooding to the site have been considered.

A screening assessment, detailed in Section 4.0, has reviewed the flood risk posed by sources including fluvial, tidal, surface water, groundwater, sewer and water mains, reservoirs, canals, and infrastructure failure. The screening assessment concluded that there are no significant risks of flooding at the site and therefore, in terms of both the Exception and Sequential Tests, the site is suitable for development.

As there are no considerable flood risks on site, allowances for changes to peak river flows, sea levels, wind speed and wave height are not required. In line with national policy, the development must make allowance for a 40% uplift in peak rainfall to accommodate for climate change over the anticipated 40-year lifetime of development, and as such, has been included within the Surface Water Drainage Strategy for the site.

6.2 Surface Water Drainage

The Surface Water Drainage Strategy has been developed to demonstrate that the requirements of national, regional, and local planning policy can be achieved at the site given the nature and the quantum of development proposed.

It is envisaged that drainage will be provided by the provision of a gravel compound / surfacing overlying the undeveloped areas of the site. Flows from the gravel compound will be piped into a swale for further attenuation and filtration prior to discharge into the existing pond at restricted rates of 1l/s. SuDS features have been designed to provide attenuation and appropriate discharge of stormwater for all events up to the 1% AEP plus a 40% climate change allowance.

In common with most drainage strategies put forward in support of planning applications, the strategy presented here will need to be subject to detailed design and any relevant approvals before construction commences.

